FOSSIL CETACEANS FROM THE FLORIDA PHOSPHATE BEDS

By Glover M. Allen

[*Plates 9–12*]

The occurrence of fossil cetaceans in Florida was briefly made known by Leidy, who, in 1889, recorded "half a dozen vertebræ and several teeth of several Cetacea of the family of the Dolphins" from the Peace Creek deposits. Concerning these remains, however, he makes no comment beyond the fact that they were "undetermined." More recently, in the commercial development of the phosphate beds, particularly in Polk County, additional fragments have come to light. Three of these are figured with brief mention, by Sellards (1915, p. 102–105) in the Seventh Annual Report of the Florida Geological Survey, but no attempt has been made to identify the species which they represent. Through the kind offices of Mr. Anton Schneider, lately Superintendent of the Amalgamated Phosphate Company, and through the interest of Vice-President F. F. Ward of the International Agricultural Corporation with works at Mulberry, the Museum of Comparative Zoölogy has recently acquired a few additional remains of fossil Cetacea from Polk County, and these, together with several fragments generously loaned by the Florida Geological Survey, form the basis of this paper.

GEOLOGICAL OCCURRENCE

All the specimens come from what are known as the "land-pebble phosphate deposits," which, according to current geological opinion (Sellards, 1915, p. 58) constitute a pebble conglomerate, accumulated under marine or estuarine conditions, probably during late Miocene or early Pliocene time. This conglomerate forms the basal member of the "Bone-Valley formation," and is derived chiefly from an older phosphatic marl of Upper Oligocene age, from which have probably been redeposited the teeth of sharks and rays, casts of invertebrates, and silicified corals that occur with the broken but unworn bones of later-deposited cetaceans and crocodilians. It is believed that this area was exposed as a land surface during most, if not all of the Miocene, at the close of which it was again submerged, thereby allowing the accumulation of the conglomerate together with the remains of aquatic vertebrates of the period, in what must have been a relatively shallow sea.

The cetacean remains consist of fragments of the skull or vertebræ, and though for the most part badly broken, seem to have suffered as much from rough handling during extraction as from actual erosion, since they are chiefly such pieces as chanced to have been rescued in the course of mining the phosphate. Exact data as to the original relations of the specimens in the deposit are therefore unobtainable.

SPECIES REPRESENTED

At least three species of cetaceans, pertaining to as many genera, are represented by the material in hand. Two of these are dolphins of the slender-beaked type common in Miocene deposits of Europe, and related to the existing Iniidæ of estuarine and fluviatile habitat. Of these, one seems referable to the genus *Schizodelphis*, first recognized as occurring in America by True (1908); the other is a related genus for which a new name is proposed. It is peculiar in that the lower tooth rows close, proximally at least, *within* the upper, instead of interlocking. What seems to be a species of the same genus is present as well in Miocene formations of Europe, though the Florida species is more progessive than the European, and appears to represent the culmination of its line of evolution. The third species falls in the Physeteridæ or sperm-whale family. It is a whale of medium size, apparently congeneric with a species—*Diaphorocetus poucheti*—described from the Miocene of Patagonia. Like that species, it differs from existing members of this family through the possession of a rostrum rather narrow basally and provided with fully functional teeth in the upper as well as in the lower jaw.

An account of these fragments follows.

INIIDÆ—River dolphins

Schizodelphis depressus sp. nov.

Plate 9, fig. 1–5

1869. ? *Priscodelphinus grandaevus* Leidy, Journ. Acad. Nat. Sci., Phila., ser. 2, vol. 7, p. 434 (in part).

1904. ? *Rhabdosteus latiradix* Case, Md. Geol. Surv., Miocene, p. 24 (in part), pl. 15, fig. 1 (not of Cope).

1908. ? *Priscodelphinus sp.?* True, Proc. Acad. Nat. Sci., Phila., p. 28, fig.1–3.

Type.—A fragment of the beak, 828 Fla. Geol. Surv., about 283 mm. in length, broken off in advance of the vomer; found five miles south of Bartow, Florida.

General characters.—A long-beaked dolphin of the *Schizodelphis* type, but

differing conspicuously from *S. sulcatus* in the flattening of the rostrum anteriorly and from *S. crassangulum* in the wider spacing and apparently greater size of the teeth. A shallow, broadly V-shaped groove occupies the midline of the palate and gradually fades out toward the tip of the beak. From the edge of this groove the plane of the maxilla slopes gently upward and outward to the strongly rounded lateral border, but near the tip of the beak the palate becomes nearly flat. The alveoli are large, the more proximal the smaller and separated by an interval less than the length of a single alveolus. The more anterior sockets are larger and farther apart, being separated by an interval nearly 1½ the length of a single alveolus. The alveoli themselves are nearly oval in outline, the more proximal directed slightly outward and forward, but the more distal with their long axes nearly parallel to the tooth rows.

Description.—This species is represented in the collection of the Florida Geological Survey by two fragments of the rostrum. The larger, here made the type of the species, is a section broken from slightly in advance of the palatal portion of the vomer. Its length is 283 mm., its breadth at base 48 mm., tapering to 37 mm. wide at the broken distal end. Its left basal end just includes the beginning of the deep longitudinal groove separating maxillary and intermaxillary. The combined intermaxillaries are at this point high (13 mm. above the groove) and broad (32 mm.) but become depressed and flattened forward, though losing little of their width. Though the right intermaxillary is very slightly the narrower, there is no marked asymmetry.

The large alveoli are nearly oval in outline and shallow. The first six or seven at the proximal end of the fragment are smaller and closer together than those succeeding and have their long axes turned slightly outward. The proximal four of the right side are smaller and closer together than those corresponding on the left side, and are included within a space of 31 mm. The separate alveoli average 6 by 3.5 mm., and are about 2 mm. apart. Beyond this point they are larger and of nearly uniform size, about 7.5 by 4.5. mm., elliptical in outline with their long axes parallel to the tooth row. The interspaces gradually increase to about 10 mm. at the anterior end of the fragment.

The second specimen (5885 Fla. Geol. Surv.) referred to this species, came from much nearer the tip of the beak. It is 172 mm. long, 28 mm. wide at the proximal and 25 mm. wide at the distal end. Its dorsal portion is largely formed by the intermaxillæ, which are nearly flat above, and have fused medially so that no trace of the original suture is evident. The combined width of the intermaxillæ is 18 mm. proximally and 13.5 mm. distally. This portion of the beak is strongly flattened dorsoventrally so that the palatal surface is nearly parallel to that of the intermaxillaries. Laterally, however, the maxillaries are slightly bevelled outward from the palate, and the tooth sockets are situated along this narrow bevelled area so that they are visible in side view. The comparatively large size, nearly elliptical outline, and wide spacing of these shallow sockets are maintained very uniformly to the anterior end of the specimen, which must have included all but a very small portion of the tip of the beak. The groove marking the line between maxillaries and intermaxillaries becomes much shallower on the right-hand side than on the left, though in the larger fragment this disparity was not noticeable.

Possibly referable to this species is the centrum of a lumbar vertebra (15786 M.C.Z.) from Mulberry. It has lost the lateral processes and the neural spine, but shows, still intact, a median dorsal ridge running nearly the entire length of the vertebra. This is low and laterally compressed, with rounded summit, and about 4 mm. high at the middle point, where on each side are one or two small pits in the groove at its base. Dal Piaz (1905) mentions a similar ridge on the vertebræ of *Schizodelphis sulcatus* and it is visible in anterior view in several of the vertebræ he figures. The centrum itself is long as compared with that of most modern dolphins, some 57 mm., lacking the posterior epiphysis. The anterior face is subcircular in outline, with a vertical diameter of 32 mm., and has a small linear depression at its center. The posterior outline is subtriangular due to the flattening of the ventral contour.

Remarks.—Of these three specimens, the larger rostral fragment recalls very strongly a similar piece from the Miocene of Shiloh, New Jersey, referred by Leidy (1869) to his *Priscodelphinus grandaevus* and figured as such by Case (1904, pl. 15, fig. 1), and again as *Priscodelphinus sp.*? by True (1908 a, p. 28, fig. 1–3). Indeed, the Florida specimen seems to offer little in itself to distinguish it from the New Jersey fragment, except that its intermaxillæ in side view are possibly higher in proportion to the maxillaries. All the fragments may therefore be provisionally considered as representing the same species. The selection of a name for them, however, is not an easy matter. For, though Leidy referred the Shiloh specimen to his *Priscodelphinus grandaevus*, the latter was really based on two caudal vertebræ of an immature animal, so that the association of the rostral fragment with these is purely assumptive, though all the bones were from the same locality. Furthermore, it is uncertain whether the caudal vertebræ on which the species *grandaevus* was founded, are congeneric with the dorsal vertebra which Leidy made the type of the genus *Priscodelphinus*. Moreover, there appears to be some ground for believing (True, 1908) that this genus is itself identical with *Schizodelphis*. If this identity could be shown through the discovery of an associated skeleton, the former name would have priority, and the latter would then become a synonym of it. But awaiting further light on the matter it seems best to retain the two generic names as originally applied. True (1908 a) in referring again to Leidy's specimen refrains from giving it a specific name, but the occurrence of what seems to be the same dolphin in the Florida deposits makes it advisable to give it a distinctive title for convenient use, even though the fragments at hand are insufficient for a complete diagnosis.

Pomatodelphis gen. nov.

Diagnosis.—Long-beaked dolphins resembling *Schizodelphis* in general form of the skull except that the rostrum has a convex expansion of the maxillary outline at the proximal end of the tooth rows; combined width of lower jaws narrower than the upper so that the lower tooth rows close *inside* the upper (like the lid of a pot—πῶμα); teeth of lower jaw directed upward into the maxillary, where the tips of the more posterior are received in shallow pits, instead of being, as in *Schizodelphis*, directed outward and interlocking with the maxillary teeth outside the tooth rows.

Genotype.—*Pomatodelphis inaequalis* sp. nov.

Pomatodelphis inaequalis sp. nov.

Plates 10, 11

Type.—A fragment, 15750 M.C.Z., from the base of the right maxilla, 114 mm. long, comprising one-half the breadth of the palate, from Brewster, Polk County, Florida. Gift of Amalgamated Phosphate Co., through Anton Schneider and Thomas Barbour.

Description.—The type fragment includes thirteen small and much compressed alveoli, of which the posteriormost are close together but the more anterior are much farther apart. All are round-edged and contract forward to a point; they are mere slits and probably did not support functional teeth. Internal and parallel to this row of thirteen alveoli is a series of some ten or eleven shallow pits made by the tips of the mandibular teeth, which closed perpendicularly against the maxilla inside the line of the upper tooth row. The palate itself is quite flat. The external border of the maxilla is abruptly and strongly rounded.

Three specimens in the collection of the Florida Geological Survey supplement the type most acceptably. They comprise a cranium, which though in several fragments wants little more than the terminal part of the beak and the middle portion of the brain case; a second imperfect rostrum, comprising most of the base of the beak; and a third fragment from near the tip of another rostrum. From these a fairly clear idea of the cranium may be gained.

The summit of the cranium instead of culminating in the elevated nasals, as in modern Delphinidæ, is formed by a transverse crest along the line of union of the frontals and the supraoccipital. The latter seems to have been nearly perpendicular to the long axis of the cranium, so that the back of the skull is rather squarely truncate. The interparietal appears medially at the apex of the skull, as a narrow transverse bone wedged in between the large supraoccipital and the frontals. It is about 40 mm. from side to side and 6 mm. in antero-posterior extent in the midline, tapering to a point at each side. In front of it appears a slightly depressed rectangular field formed by the frontals, some 25 mm. square against the anterior side of which abut the remains of the nasals.

The blowholes are embraced by the proximal ascending portions of the intermaxillæ, the tips of which are here contracted to a blunt point in contact with the middle of the frontal on either side, some 10 mm. in advance of the transverse occipito-frontal ridge. A large foramen opens under the posterior margin of

each intermaxillary. It is continued forward and inward beneath this bone and is probably the opening of a perforation of the maxillary quite obvious in most modern dolphins, but here covered by the expanded intermaxillary. The backward extension of the maxillary almost completely covers the outer part of the frontal, at least on the right-hand side, and thus heightens the appearance of fore-and-aft compression of the brain case.

The intermaxillaries are broad, thin and nearly plane posteriorly, but quickly become narrower opposite the front of the blowholes, and then slightly expand, their surfaces sloping inward toward the triangular area in front of the nares, before continuing forward on to the beak. A very shallow groove runs from near the outermost part of this proximal expansion, forward and inward, becoming lost at the inner sloping margin of the triangular area. A similar groove is present in *Schizodelphis*. At this level commences a marked asymmetry. The right intermaxillary suddenly narrows while the left broadens out for a short distance and becomes much thinner at its outer edge. Forward from this point both intermaxillaries become raised and thickened, extending as two parallel flat-topped ridges, closely appressed medially, to the broken extremity of the beak. From the flattened maxillaries they are sharply marked off by a deep longitudinal groove along the line of contact. The right intermaxillary is markedly the smaller and its delimiting groove the shallower.

A fragment (2343 Fla. Geol. Surv.) from very near the tip of a rostrum, and apparently representing the same species, shows that the two intermaxillaries fuse medially toward their distal extremity.

The base of the rostrum is peculiar in outline. Opposite the anterior tips of the pterygoids it becomes strongly compressed from side to side, with gently concave margins as seen from below; then it expands widely, reaching the greatest convexity opposite the base of the visible part of the vomer, beyond which it tapers forward to form the beak. The tooth rows begin just in advance of the widest expansion. There is thus a distinct neck formed at the base of the rostrum succeeded by a convex expansion, very different from the gradual and even taper from the maxillary notches forward, seen in *Schizodelphis*. A somewhat similar outline is seen, however, in the newly discovered living genus, *Lipotes* (Miller, 1918). In ventral aspect, the entire palate in advance of the vomer is quite flat with a shallow median V-shaped groove where the bevelled edges of the maxillaries meet. It thus differs markedly from *Schizodelphis sulcatus*, in which according to the figures of Dal Piaz (1903, p. 195) the maxillaries are strongly bevelled outward. At the base of the rostrum the pronounced asymmetry previously noted in the dorsal aspect is again evident. For while on the left-hand side of the beak the proximal part of the maxilla widely expands, carrying with it the tooth row, on the right-hand side the expansion is less marked, and the palatal surface is much more nearly in a vertical plane so that the tooth row is placed much higher on the cheek. The alveoli are also smaller and closer together on the right-hand side in this region.

The vomer appears in advance of the palatals as a narrow lozenge-shaped slip about 100 mm. long by 8 wide in the broadest place. Fortunately enough remains of the posterior end of the vomer to fix the shape and position of the blowholes. That of the right-hand side is much the smaller and opens well to the right of the median axis of the skull, while that of the left side is so much larger

and has so encroached on its neighbor that it has come to occupy a median position. This asymmetry seems not to be found in *Schizodelphis* (the apparent asymmetry shown in Dal Piaz's figures, 1903, pl. 1, is obviously due to distortion of the fossil). Although an accurate measurement is not possible, the left blowhole seems to have been at least 20 mm. in antero-posterior diameter, the right-hand blowhole about 14 mm.

The alveoli of the upper jaw, particularly those of the right-hand side, are more or less slit-like, rounded posteriorly and contracted to a point forward. Their edges instead of being sharply defined, are rounded, with a healed-over appearance, and it seems probable that if teeth were present at all in the upper jaw they must have been very small, non-functional, and with bases buried in the gums instead of fitting into sockets. The posterior alveoli of the left side are apparently a little larger at the base of the rostrum and may have held small teeth.

Most remarkable is the series of depressions seen on the palate *internal* to each tooth row, in at least the basal portion of the beak. These are obviously made by the tips of the *mandibular* teeth, and may or may not come opposite the alveoli of the upper jaw. Their presence indicates that the teeth of the mandible closed vertically *into the maxilla*, that they were larger than the maxillary teeth if any existed, and that the width across the lower tooth rows was less than that across the upper alveolar series. This allowed the upper jaw to close over the lower jaw like the lid of a pot. A certain parallelism may be seen here with the sperm whale, in which the lower jaws are in like manner narrower than the width between the upper alveolar lines, the rostrum has at the same time become expanded, and the upper teeth have become functionless. No doubt this modification is a result of a change from an actively fish-capturing habit to one requiring less seizing and holding as in the squid-eating (teuthophagous) cetaceans generally.

In the fragment, from the right side near the base of the rostrum, there are 6 alveoli in a space of 33 mm., with intervals of from 2 to 8 or 9 mm. between them, and 6 depressions formed by the mandibular teeth in a space of 55 mm. In the larger rostral fragment (5834 Fla. Geol. Surv.) there are:

Right side	6 alveoli in 32 mm. near base
	6 alveoli in 56 mm. near end
	6 depressions in 50 mm. about halfway
Left side	6 alveoli in 53 mm. near base
	6 alveoli in 68 mm. about halfway
	6 depressions in 69 mm. about halfway

In the small fragment from the tip of the beak (2343 Fla. Geol. Surv.) there appear to be 6 aleovli in about 35 mm.

The posterior end of the cranium (5834 Fla. Geol. Surv.) which has served for the greater part of the above description, is considerably broken, but enough fragments remain to afford a good idea of its appearance. The condyles are large and prominent yet quite without the distinct neck shown in skulls of *Schizodelphis sulcatus* (Abel, 1899; Dal Piaz, 1903). That of the right side is the larger. The lack of a distinct neck to the cranial condyles and their large smooth surface tending to merge with that of the occiput show a progressive condition considerably ahead of the latter genus. The greater fore-and-aft compression is further shown by the notably shorter distance both relatively and absolutely between

the glenoid cavity of the jaw and the cranial condyles. The occipital crests arise as sharp ridges from the upper side of the squamosal processes, and meet in a transverse ridge at the summit of the skull. Posteriorly the squamosal and adjacent surfaces are irregularly pitted or roughened for muscle attachments, quite unlike the smooth surfaces in skulls of modern dolphins. The glenoid cavity for the articulation of the jaw is relatively small, a primitive feature, and that of the right side is the smaller. A broad groove bounds the lower inner margin of the articulating surface.

The specimen affords the following complete measurements:

	mm.
Extreme width of skull across squamosal processes	199.0
Width of braincase across bases of same	143.0
Width across occipital condyles	91.5
Right condyle, greatest vertical diameter	52.0
Right condyle, greatest transverse diameter	32.0
Left condyle, greatest vertical diameter	49.0
Left condyle, greatest transverse diameter	30.5
Foramen magnum, greatest vertical diameter	27.0
Foramen magnum, greatest transverse diameter	40.0
Lip of foramen magnum to basisphenoid suture	81.0

Remarks.—In establishing this new genus and species a careful review of the literature has been made in order to ascertain if other specimens, congeneric with it, have been described. It is obvious that species and genera based on other parts of the skeleton than the cranium can at present afford no sure points of comparison. There are, however, two specimens from the Miocene of Europe, that appear to be referable to the new genus. The first of these is a fragment of the right maxilla first mentioned and figured by Cuvier (Rech. sur les Oss. Foss., 1823, ed. 2, vol. 5, pt. 1, p. 317, pl. 23, fig. 38) as belonging to a "dauphin dont une portion de mâchoire supérieure a été trouvée dans le calcaire grossier du département de l'Orne." In the fourth edition of the same work (1836) the specimen is said to be from the "département de Maine-et-Loire." Whichever locality may be correct, it is fairly certain that the horizon is Miocene, probably middle Miocene. The specimen is next referred to by Holl (1829) in a work rarely cited, Handbuch der Petrefactenkunde. Here it is listed as "*Delphinus stenorhynchus* Cuv." with brief mention and reference to Cuvier's work. The latter author, however, though having observed in his original account, that the species was unlike any other hitherto described, gave it no name either in this or in the later editions of the Ossemens Fossiles, and apparently quite overlooked or ignored Holl's name. Thus Holl, though citing Cuvier as authority, seems to have been himself the actual author. Later writers, including Brandt,

have attributed the name to Keferstein (1834), who, however, cites it without reference as a synonym of *D. longirostris*, a name applied to a living species of *Prodelphinus* by Gray in 1828, and to a species of *Delphinus* by Dussumier in 1829. In 1846, Laurillard, evidently supposing that the fossil required a new specific designation formally bestowed the name *Delphinus renovi* upon it after the original discoverer, and it is so figured in three views by Van Beneden and Gervais in the Ostéographie. Finally, Longhi in 1898, referred it to the genus *Champsodelphis*. As may be gathered from the figure (Text-fig. 1), it agrees with the Florida species in the strongly convex outline of the base of the maxilla. In both, the proximal end of the tooth row makes

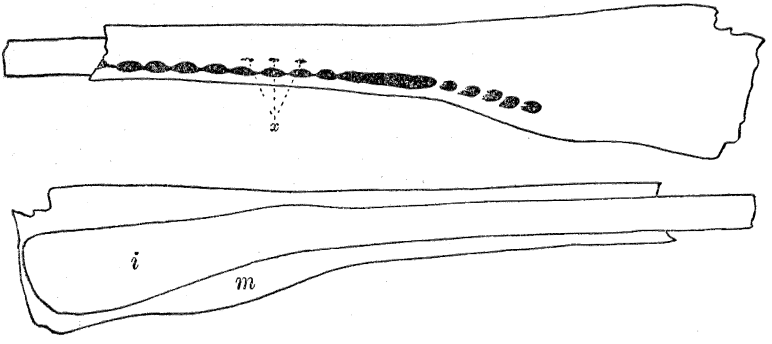

FIG. 1. *Pomatodelphis stenorhynchus* (HOLL)

Dorsal (lower fig.) and ventral (upper fig.) outlines of the type specimen. France, Département de l'Orne. After Van Beneden and Gervais, Ostéographie, pl. 57, fig. 9. *i*, intermaxillary; *m*, maxillary; *x*, depressions for reception of mandibular teeth.

an outward bend at this point, but in the French specimen the row of alveoli ends about opposite the summit of the convexity, whereas in the Florida species it ends in advance of this point. Moreover, the alveoli themselves seem much larger in the former and doubtless supported functional teeth. A more important point is indicated in the figure by the presence of three shallow depressions near the middle of the length, internal to the alveolar row, for the reception of the points of the corresponding mandibular teeth. This detail, perhaps not fully brought out by the artist, shows that the lower tooth row closed *within* the upper, at least proximally, and, taken in connection with the similarity of the maxillary outline, seems to indicate at least a generic affinity with *Pomatodelphis*.

It seems almost certain that Paquier's *Schizodelphis depereti* is the same species as that represented by Cuvier's fragment. The type specimen comprises the cranium forward of the blowholes and most of the lower jaw, but the rostrum has been broken off somewhere near its middle. The excellent photographs of the specimen show the same convexity at the base of the maxillary, while the broken and projecting end of the lower jaw is obviously much narrower than the upper at the same point, as if it had closed *inside* the latter, a point further indicated by the fact that the small lower tooth preserved is expressly stated to have its tip hidden in the upper maxillary. In both dorsal and ventral views, the right and the left sides show no marked asymmetry. Abel (1899) though admitting many discrepancies between this skull and that of *Schizodelphis sulcatus*, nevertheless dismisses it as representing probably the latter species. The locality of Paquier's specimen is southern France, "les carrières de Chamaret (Drôme)" in the Rhone valley. The formation is the "mollasse burdigalienne," considered to be lower Miocene. Assuming that Paquier's specimen represents the same species as Cuvier's from northern France, the synonymy will stand as follows:

Pomatodelphis stenorhynchus (Holl)

1823. Dauphin . . . . du département de l'Orne, G. Cuvier, Rech. sur les Ossemens fossiles, ed. 2, vol. 5, pt. 1, p. 317, pl. 23, fig. 38 (see ed. 5, 1836, p. 168, pl. 224).
1829. *Delphinus stenorhynchus* Holl, Handbuch d. Petrefactenkunde, part 1, p. 70.
1834. *Delphinus longirostris* oder *stenorhynchus* Keferstein, Die Naturgeschichte des Erdkörpers, vol. 2, p. 203 (not *D. longirostris* Gray, 1828; not Dussumier, 1829).
1841. *Delphinus longirostris* H. von Meyer, Neues Jahrb. f. Mineral., 1841, p. 327.
1844. *Delphinus renovi* Laurillard, in D'Orbigny, Dict. Univ. d'Hist. Nat., vol. 4, p. 634, pl. fig. 38.
1873. *Delphinus renui* Brandt, Mém. Acad. Imp. Sci. St. Pétersbourg, ser. 7, vol. 20, p. 247 (*emendatio*).
1894. *Schizodelphis depereti* Paquier, Mém. Soc. Géol. de France, vol. 4, no. 12, p. 7.
1898. *Champsodelphis renovi* Longhi, Atti Soc. Veneto-Trent. Sci. Nat., Padova, ser. 2, vol. 3, p. 333.

Though referred to the same genus, there seem ample grounds for considering the French species distinct from the Florida one. The figures of the former, especially that of Cuvier representing the right maxillary, show the proximal alveoli large and somewhat closely

crowded, instead of small and well spaced. The intermaxillaries in profile do not curve upward so abruptly, their outline as seen from above is different, and there is no such marked asymmetry as shown in *P. inaequalis*. The latter in its greater specialization seems to be a more progressive species, as might perhaps be anticipated from its supposedly later geologic appearance (upper Miocene or lower Pliocene).

The peculiar vertical implantation of the mandibular teeth, and the fact that at least the more proximal close within the maxillary rows, suggest a possible relationship to *Platanista*, in which exactly these conditions occur at the base of the beak, although in other respects the latter genus shows far greater specialization, as in the greater compression from side to side, of the entire rostrum. The development of its characteristic maxillary crests seems of less systematic importance, for incipient crests are found in *Phocæna* on the intermaxillaries, and very large ones in *Hyperoodon* on the maxillary bones.

PHYSETERIDÆ—SPERM WHALES

Diaphorocetus mediatlanticus (Cope)

Plate 9, fig. 6; Plate 12

1895. *Paracetus mediatlanticus* COPE, Proc. Amer. Phil. Soc., vol. 34, p. 135.
1902. *Hypocetus mediatlanticus* HAY, Bull. U. S. Geol. Surv., no 179, p. 596; CASE, Md. Geol. Surv., Miocene, 1904, p. 30, pl. 17, figs. 6a, 6b.
1904. *Hypocetus atlanticus* CASE, Md. Geol. Surv., Miocene, expl. of plates, p. 9 (*errorim*).
1898. *Diaphorocetus mediatlanticus* TROUESSART, Cat. Mamm., new. ed., p. 1053; 3d ed., 1905, p. 772.

To this genus and species are referred a fragment of the lower jaw, including both rami, from the phosphate beds at Brewster, Polk County, and a second fragment comprising the occipital condyles, from Mulberry. Apparently pertaining to the same species is the beautiful specimen figured by Sellards (1915, p. 103, fig. 32), also found at Mulberry, consisting of the basal portion of the rostrum including both upper and lower jaws. Most unfortunately, this piece, which was for a time in the possession of the International Agricultural Corporation, has been disposed of and cannot be traced.

The genus *Hypocetus* was established by Lydekker in 1893, as a substitute for *Mesocetus* (preoccupied) of Moreno (1892), type *Mesocetus poucheti*, a medium-sized cetacean of the sperm-whale family,

with well developed, functional teeth in the upper as well as in the lower jaw. On a subsequent page of the same paper, Lydekker, evidently through inadvertence, calls the genus *Paracetus*, but *Hypocetus* has page priority. This paper, though bearing date 1893, was actually issued in April, 1894, and is, therefore, later than a paper by Ameghino dated February, 1894, in which the generic term *Diaphorocetus* is proposed for the same specimen and thus has priority (see Palmer, Index Gen. Mamm., 1904, p. 341). A further difficulty in the specific reference lies in the fact that it is not clear whether Cope's species *mediatlanticus* really differs from Moreno's *poucheti*. The type of the latter is a fairly well preserved skull lacking the jaw, from Bahia Nueva, Chubut Territory, Patagonia, found in a formation which Ameghino believed to be of Eocene age, but which is now considered to be lower Miocene (True, 1910, p. 31). Cope's type of *mediatlanticus* is a large fragment consisting of the base of the rostrum with the alveoli of the proximal seven or eight pairs of maxillary teeth, and parts of the intermaxillaries, vomer, and adjacent bones. It is from the St. Mary's formation at Drum Point, Maryland, now regarded (Cushman, 1920, table opp. p. 40) as of upper Miocene age. Cope attempts no comparison of his specimen with Moreno's *poucheti*, beyond the statement that the two are "not distantly related." From Case's figure of the type, however, it appears that the alveolar row extended back only to the level of the middle of the vomer, whereas, in Moreno's figure (1892, pl. 10) of *poucheti*, indications of alveoli seem to continue considerably posterior to the vomer. A slight difference in the outlines of the palatal bones is also seen, but how far these differences are individual rather than specific must await the discovery of additional specimens. It therefore seems best to retain Cope's name *mediatlanticus* for the present and to refer the Florida fragments provisionally to it. A description of these follows.

(1) The finest specimen of all is the fragment of rostrum figured by Sellards (1915, p. 103, fig. 32), as the "side view of upper and lower jaw of another cetacean." It is shown at about one-half natural size and was 300 mm. long, comprising a portion of both jaws broken from slightly in advance of the symphysis. It obviously includes some of the posteriormost of the teeth. Its upper profile is nearly plane with a line parallel to it marking the suture between maxillary and intermaxillary. The ventral outline of the lower jaw shows the distinct angle at the beginning of the symphysis so characteristic of the sperm whales. Posteriorly from this angle the teeth of both jaws at once show a successive diminution in size, while in advance of it they are all of a nearly uniform size and

spacing. The opposing series of the two jaws interlock, with the points of the teeth directed outward, those of the more posterior slightly recurved. A longitudinal crack appears in the mandible, evidently due to crushing. The photograph shows very clearly that the teeth had distinct crowns, doubtless of enamel, which stand out dark and discolored in contrast to the white of the exposed roots. Eleven maxillary teeth are apparent in the figure and at least ten mandibular teeth (Plate 12, fig. 13).

(2) The second fragment is from Brewster, Polk County (15751 M.C.Z.), the gift of Dr. Thomas Barbour. It is a section, some 150 mm. long, of the conjoined mandibles beginning slightly in advance of the symphysis. At the posterior end the rami are separate for about 20 mm.; in front of this point they begin to contract slightly in width and are thoroughly fused together with the line of contact deeply impressed. Three complete alveoli with parts of two others are present in each ramus. The posteriormost on the right side is the smallest. It contains a root still in place and is separated by a narrow interval from the alveolus next in advance. The three succeeding alveoli are about of the same size with interspaces greater than those separating the alveoli of the left side. From this it results that the corresponding sockets of opposite sides are not in the same transverse plane, but alternate with the opposite interspaces. The lengths of these sockets and interspaces are:

	Left ramus	*Right ramus*
Proximal socket	—	18
First interspace	10	2
Second socket	22.5	20
Second interspace	9.5	12
Third socket	20	22
Third interspace	8	15
Fourth socket	20	20
Fourth interspace	15±	16±
Combined length of middle three sockets	78	90

A slight asymmetry is thus evident in the rami of opposite sides.

The two roots still in place are broken off at the level of the jaw and are nearly oval in section, with the longest transverse diameter turned outward and forward in the posteriormost but nearly parallel with the tooth row in the anteriormost tooth. In side view are seen several short and shallow depressions in the rami marking the exit of the mental nerves. About halfway up on the ramus a very shallow longitudinal groove is evident, beginning from the most proximal of these exits just in front of the symphysis.

(3) The third fragment referred to this species is a portion of the base of a skull from Mulberry, comprising the occipital condyles (15787 M.C.Z.). These are prominent and rounded, though but slightly marked off from the occipital surface by a raised border. Their greatest vertical diameter is very nearly at right angles to the transverse plane of the skull, and the greatest width is at about the middle point of their height. In measurements they are practically identical with those recorded by Moreno for *D. poucheti*.

MEASUREMENTS OF 15787 M.C.Z.

	mm.
Greatest transverse width across both condyles	144
Greatest vertical diameter of right condyle	93+
Greatest vertical diameter of left condyle	100±
Greatest width of right condyle	57
Greatest width of left condyle	59
Distance between right and left condyles above	41
Distance between right and left condyles below	14
Foramen magnum, vertical diameter	63±
Foramen magnum, transverse diameter	45

It is possible that a cetacean vertebra from Brewster figured by Sellards (1915, p. 105, fig. 33) belonged to a whale of this same species.

SUMMARY

It is evident that the three fossil cetaceans here noticed have much in common with species occurring elsewhere in Miocene formations. The first, *Schizodelphis depressus*, is closely allied to a species represented in the Miocene of Shiloh, New Jersey, if indeed it is not identical with it. The second, *Pomatodelphis inaequalis*, is referred to a new genus that apparently occurs as well in the lower and the middle Miocene of France, where, however, it is represented by a less specialized species. The implantation of the teeth suggests a possible relationship to *Platanista*, though it is considered one of the Iniidæ. The third is closely related to a cetacean described from the lower Miocene of Patagonia and is believed to be identical with a species, *Diaphorocetus mediatlanticus*, discovered in the upper Miocene of Maryland. On the whole, therefore, the evidence of the cetacean remains points to a late Miocene age for these "pebble phosphate" deposits of Florida. The two species of Iniidæ seem to represent the terminal members of a group now extinct, though related to the existing river dolphins. The one Physeteroid is a more primitive representative of a group that has survived to the present day, but whose living members, perhaps through a change from fish-eating to squid-eating habits, have lost the functional teeth of the upper jaw.

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EXPLANATION OF PLATES

PLATE 9

FIG. 1. *Schizodelphis depressus*, sp. nov. Palatal view of basal portion of beak, from near Barstow, Florida. Type, 828 Fla. Geol. Surv. × .39.

Fig. 2. Dorsal view of same.

FIG. 3. *S. depressus*, a fragment from near tip of beak. 5885 Fla. Geol. Surv. × .39.

FIG. 4. Dorsal view of same, showing fusion of intermaxillaries.

FIG. 5. Centrum of a lumbar vertebra referred to *S. depressus*, showing median ridge projecting into neural canal. Mulberry, Fla. 15786 M.C.Z. × .39.

FIG. 6. *Diaphorocetus mediatlanticus* (Cope). Cranial condyles, posterior view. Mulberry, Fla. 15787 M.C.Z. × .43.

PLATE 10

FIG. 7. *Pomatodelphis inaequalis*, sp. et gen. nov. Portion of rostrum, palatal view, showing the asymmetry of structure, and the row of depressions for tips of mandibular teeth internal to the maxillary tooth row. Those of left side partly filled by plaster. *n*, *n*, the blowholes; *v*, vomer. 5834 Fla. Geol. Surv. × .5.

FIG. 8. Dorsal view, showing the entire specimen. × .44.

FIG. 9. *P. inaequalis*, a fragment from near tip of beak, dorsal view, showing fusion of intermaxillaries, and dorso-ventral flattening. 2343 Fla. Geol. Surv. × .75.

PLATE 11

FIG. 10. *Pomatodelphis inaequalis*, palatal view of fragment of right maxilla. The nine depressions for reception of mandibular teeth are indicated by dotted line to center of each. Brewster, Fla. Type. 15750 M. C. Z. × .90.

FIG. 11. Same, dorsal view of summit of skull, showing (outlines dotted): frontals (*f*), bases of intermaxillaries (*i*) and maxillaries (*m*), interparietal (*ip*), and part of supraoccipital (*so*). 5834 Fla. Geol. Surv. × .50.

FIG. 12. Same, posterior view of supraoccipital fragment (above), condyles, and squamosal processes of cranium. 5834 Fla. Geol. Surv. × .50.

PLATE 12

FIG. 13. *Diaphorocetus mediatlanticus* (Cope), base of rostrum in side view, showing teeth in both jaws. Found near Mulberry, Fla., but now lost. (Cut loaned by Fla. Geol. Surv.; see Sellards, 1915, p. 103). × .50.

FIG. 14. Same, dorsal view of jaw fragment from just in advance of symphysis. Brewster, Polk Co., Fla. 15751 M.C.Z. × .83.

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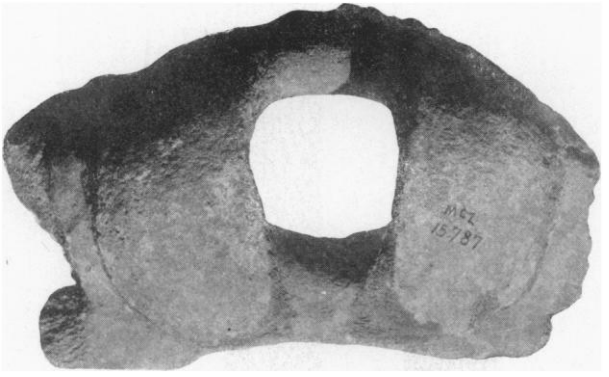

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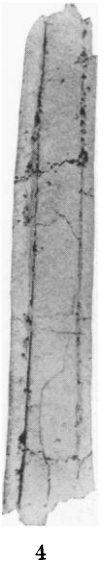

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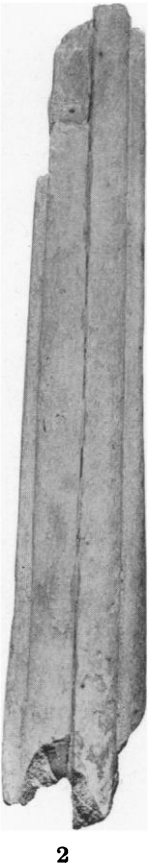

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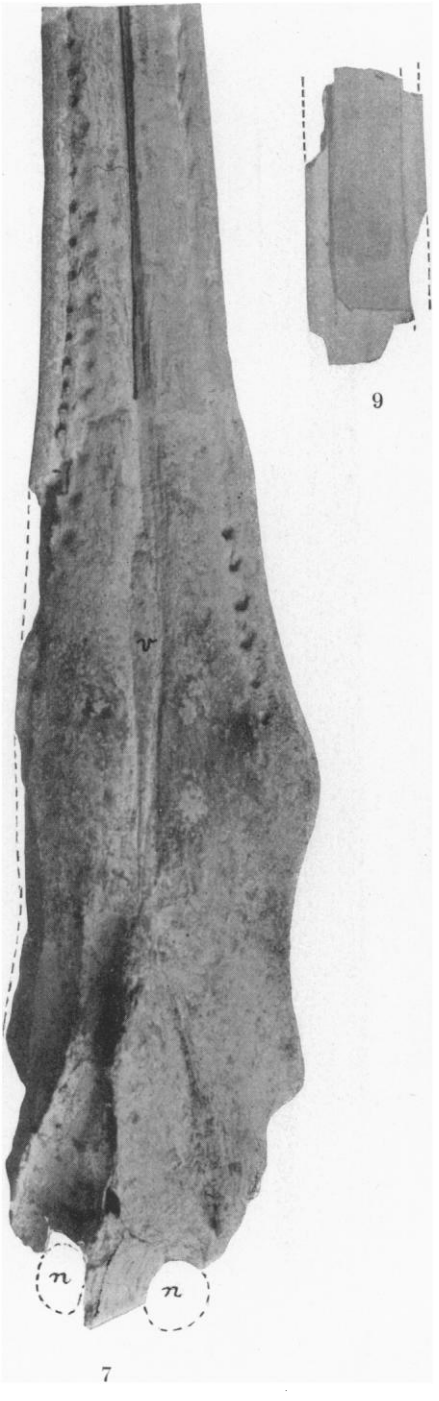

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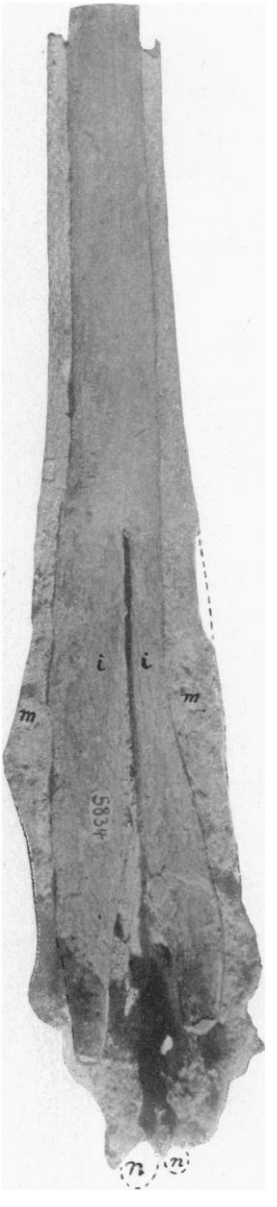

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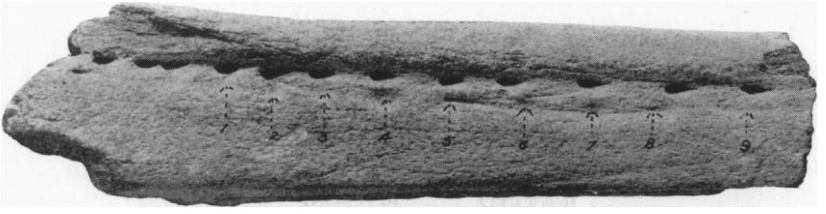

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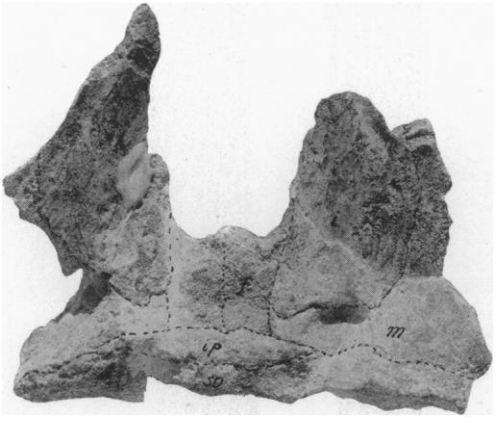

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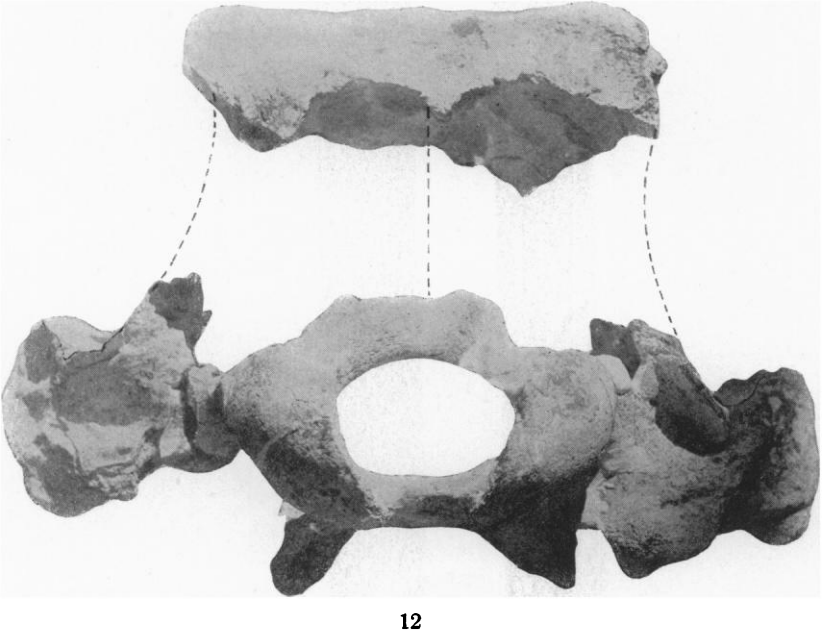

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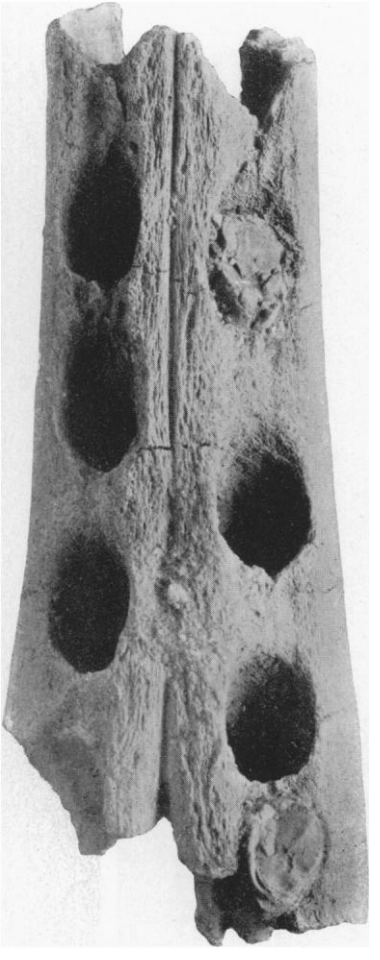

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